It’s All In Your Head!

RADY Resident Symposium: Head CT

Kali Xu MD
Jeremy Kim MD, Sheryl Jordan MD
Learning objectives

By the end of this activity, participants will be able to:

1. Describe the utility of head CTs
2. State head CT anatomy
3. Describe a suggested approach to reviewing head CTs
4. Understand the head CT basics of hydrocephalus and types of intracranial hemorrhage
Module Outline

I. Head CT facts and description of modalities
II. Anatomy on head CT
III. Approach to head CT interpretation
IV. Common head CT findings
Head CT Facts

- Head CT is usually performed for acute neurologic illness, such as trauma or suspected stroke
  - MRI is typically used for subacute or chronic conditions, or to clarify findings

- Pros: fast, widely available, less susceptible to motion than MRI, no contraindications with implanted devices or foreign bodies

- Cons: significant radiation dose (2 mSv for routine head CT), expensive examination

- Performed with or without IV contrast
  - Risks of contrast problems: allergic reaction, contrast-induced nephropathy
Noncontrast Head CT

• First-line imaging for acute neurologic illness
  – No risk of contrast problems

• Indications: trauma, stroke, hemorrhage, hydrocephalus

Contrast Head CT

• Limited indications; MRI usually preferred

• Indications: abscess, infection, cancer (primary or mets)
  – CT with IV contrast only if patient not able to undergo MRI (gadolinium allergy, severe claustrophobia, metallic implant)
  – Positive CT finding may require MRI
CT Angiography (CTA) Head

- IV contrast is administered in arterial phase
  - Looks at vessels

- Indications: aneurysms, AVM, thrombosis, dissection
  - Stroke if planning for intra-arterial thrombectomy
CT Other

CT Orbits
- With or without contrast
- Without contrast: foreign body or trauma
- With contrast: tumor, mass, infection
- Only covers the orbits/includes sinuses

CT Maxillofacial
- With or without contrast
- Without contrast: sinus disease or trauma
- With contrast: tumor, mass, infection
- Includes the whole face including mandible
Tissue Densities and CT Windows

Gray matter: 25-40 HU*
- Contains cell bodies, dendrites, axon terminals
- Cortex & deep gray matter nuclei

White matter: 25-30 HU
- Contains axons (myelinated)
- Subcortical white matter & white matter tracts

CSF: 0-20 HU

Blood: 40-70 HU (acute)
- Older blood is less dense, becomes more like water

*HU=Hounsfield unit, scale measuring radiodensity where the radiodensity of water=0 HU

CT Windows:
- Brain
- SDH aka blood
- Stroke
- Bone
Head CT Examples

Bone window – visualize fractures
Head CT Examples

Bone window – visualize sinuses
Head CT Examples

Brain window – visualize the gray-white matter interface
Head CT Examples

Subdural (blood)

Stroke (high contrast)
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Anatomy: Vertex Level

Superior frontal gyrus
Middle frontal gyrus
Precentral gyrus (Frontal lobe)
Postcentral gyrus (Parietal lobe)
Central sulcus
Precentral sulcus
Postcentral sulcus
Falx cerebri
Superior frontal sulcus
Pars marginalis

The following views will scroll downward from vertex to foramen magnum. Note the bolded landmarks!
Anatomy: Lateral Ventricle Level

- Caudate body
- Central sulcus
- Lateral (Sylvian) fissure, posterior segment
- Superior temporal sulcus
- Superior temporal gyrus
- Intra-occipital sulcus
- Superior sagittal sinus
- Corona radiata
- Lateral ventricle
- Parieto-occipital fissure

Note the bolded landmarks!
Anatomy: 3rd Ventricle Level

- Caudate, head
- Basal ganglia, lentiform nuclei (GP & putamen)
- Insula
- 3rd ventricle
- Superior temporal sulcus
- Parieto-occipital fissure
- Lateral ventricle, frontal horn
- Internal capsule, anterior limb
- Lateral (Sylvian) fissure
- Internal capsule, posterior limb
- Thalamus
- Lateral ventricle, occipital horn
- Calcarine sulcus

Note the bolded landmarks!
Anatomy: Midbrain Level

- Superior temporal gyrus
- Cerebral aqueduct (of Sylvius)
- Lateral (Sylvian) fissure
- Midbrain
- Quadrigeminal cistern

Note the bolded landmarks!
Anatomy: Suprasellar Cistern Level

Note the bolded landmarks!

- Olfactory sulcus
- Suprasellar cistern
- Interpeduncular cistern
- Ambient cistern
- Gyrus rectus
- Amygdala
- Cerebral peduncle
- Hippocampus
- Cerebellum
Anatomy: Brachium Pontis Level

- Temporal lobe
- Cerebellopontine angle cistern
- Middle cerebellar peduncle (brachium pontis)
- Cerebellar hemisphere
- Sellar turcica
- Prepontine cistern
- Pons
- Sigmoid sinus
- 4th ventricle
- Vermis

Note the bolded landmarks!
Anatomy: Foramen Magnum Level

Foramen magnum
Nasopharynx
Mastoids
Cerebellar tonsil
Mandibular condyle
Medulla

Note the bolded landmarks!
Anatomy: Ventricular System

- Network of ependymal-lined CSF-filled spaces
  - Derivative of neural tube cavity

- 4 ventricles:
  - Paired lateral ventricles
  - 3rd ventricle
  - 4th ventricle
Anatomy: Lateral & 3\textsuperscript{rd} Ventricles

- Frontal horn, lateral ventricle
- Foramen of Monro
- 3\textsuperscript{rd} ventricle
- Occipital horn, lateral ventricle

Body, lateral ventricle
Anatomy: 3\textsuperscript{rd} and 4\textsuperscript{th} Ventricles

- 3\textsuperscript{rd} ventricle
- Cerebral aqueduct (of Sylvius)
- 4\textsuperscript{th} ventricle
Anatomy: Subarachnoid Cisterns

- Suprasellar cistern
- Sylvian fissure
- Interpeduncular cistern
- Ambient cistern
- Quadrigeminal plate cistern
- Prepontine cistern
- CP angle cistern
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Emergency Head CT Checklist

- Is there midline shift?
- Is brain symmetry preserved?
- Are the cisterns patent (smile and pentagon)?
- Is the 4th ventricle patent and symmetric?
- Are the ventricles enlarged with sulcal effacement?
Mnemonic: Blood Can Be Very Bad

- Blood: intra- or extra-axial
- Cisterns and sulci: effacement or asymmetry
- Brain parenchyma: gray/white differentiation, symmetry, shift, density
- Ventricles: too large or too small
- Bones: skull fx, sinuses, mastoids, extracranial soft tissues
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Case 1: Headache

What is causing the headache?
Case 1: Headache caused by hydrocephalus

Obstructed below 4\textsuperscript{th} ventricle; all ventricles are dilated!
Cases 2 & 3: Closed Head Injury
Case 2: Subdural Hemorrhage

- **Subdural** hemorrhage (SDH) collects in the potential space between the inner dura and the arachnoid layer.

- Results from bridging vein tears in MVAs, falls.

- On CT: crescentic shape, hyperdense when acute, then isodense to hypodense when subacute and chronic.

- Mass effect -> altered mental status.
Case 2: Subdural Hemorrhage

- **Subdural** hemorrhage CT checklist:
  - Midline shift
  - Loss of symmetry
  - Cisternal effacement

- Subfalcine and uncal herniation
  → Neuro-ICU!
Case 3: Epidural Hemorrhage

- **Epidural** hemorrhage forms between inner table of calvarium and outer layer of dura

- Results from middle meningeal artery tear

- >90% are associated with skull fx, usually in temporoparietal bones; can also be in frontal and parieto-occipital regions

- On CT: hyperdense biconvex lens shape

- Mass effect -> altered mental status

- Early identification critical to guide evacuation vs. early re-evaluation
Cases 2 & 3: Closed Head Injury
Case 4: Worst Headache of Her Life
Case 4: Subarachnoid Hemorrhage

- **Subarachnoid** hemorrhage collects in the space between the pia and the arachnoid membrane.

- Think trauma, aneurysm, HTN, AVM.

- On CT: hyperdensity outlining the sulci and basilar cisterns, usually does not cause mass effect or edema.
Case 5: Malignant Hypertension
Case 5: Intracerebral Hemorrhage

- **Intracerebral** hemorrhage occurs in the brain tissue and/or ventricles

- Biggest risk factors: HTN, amyloidosis
  - Typical locations of hypertensive hemorrhage: basal ganglia, thalamus, pons, cerebellar hemisphere

- On CT: hyperdense when acute
Head CT Recap

- Noncontrast head CT indications: trauma, stroke, hemorrhage, hydrocephalus
- CT windows: brain, SDH, stroke, bone
- Emergency checklist: shift, symmetry, cisterns, 4th ventricle, hydrocephalus
- Interpretation mnemonic: Blood Can Be Very Bad
- Emergency findings: hydrocephalus, subdural, epidural, subarachnoid, and intracerebral hemorrhage
References


